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No. 8. Vol. VIII. August, 1915.

The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by LEON GASTER

10/6 Yearly. THE JOURNAL OF SCIENTIFIC ILLUMINATION. *1/- a Copy.*

OFFICIAL ORGAN OF THE
Illuminating Engineering Society.
(Founded in London 1909.)

This number contains special articles emphasising the Economic and Hygienic aspects of *Factory Lighting*, and giving particulars of a number of typical modern installations.

Other matters dealt with include :—

THE APPLICATION OF EDUCATIONAL METHODS TO THE REDUCTION OF ACCIDENTS—THE PHOTOGRAPHIC VALUE OF VARIOUS ILLUMINANTS—SPECIAL PROBLEMS IN RAILWAY LIGHTING—THE NINTH ANNUAL CONVENTION TO THE ILLUMINATING ENGINEERING SOCIETY (U.S.A.), &c.

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EDITORIAL.

Deliberation—then Organisation.

In our last issue we ventured to make a few suggestions regarding the Organisation of Science, and the avoidance of overlapping effort. Besides the newly created Ministry of Munitions we have now the two separate Boards of Invention assisting respectively this Ministry and the War Office, and the Admiralty; and a third Advisory Council on Industrial Research. We have also in progress a vast scheme of National Registration, the utility of which must depend radically on the judgment which with the returns of skilled labour are analysed.

All these are admittedly emergency measures, taken in order to meet the exceptional and momentous circumstances of the present time. There is every reason to hope and believe that they will accomplish most useful work; but as organisations these bodies are naturally less complete than those developed as a result of long and careful reflection and perfected by experience over many years. This point was excellently put by Lord Haldane in a recent article in *The Nation*. "The possession of ideas," he said, "is, in a vigorous people, the real source of organisation." In other words before we can organise we must have a clear and concrete conception of the purpose to be attained. Deliberation must precede organisation. We venture to think that those people who vehemently press for a sudden effort of organisa-

tion, without forming a detailed and clear idea of its purpose, know little of the elaborate scheme of things evolved through long and painful thought by our adversaries and gradually brought to perfection through many years. One point which will doubtless receive consideration from the authorities is the desirability of inter-communication between the various Councils. Probably many suggestions brought before the Admiralty Board of Inventions would be of interest to the Council assisting the Ministry of Munitions. Opportunities might therefore be provided for members of all the Councils to confer on matters falling within their special province as experts.

It is also worth while to inquire whether, at this stage, it would not be desirable to form some central body—something of the nature of the "General Staff" suggested by Lord Haldane—whose function it would be to survey the situation as a whole and to correlate the activities of the various departments organised for war. During the past few months we have suffered all the natural results of our unprepared state. We have seen in turn each aspect of the war receive prominence—first the need of men, then the need of munitions and men to produce them, then the dislocation of our wealth-producing capacities which pursuit of the first two objects entails. On the other hand we have certainly learned much by our experience, and are now in a better position to organise the resources of the nation on a scientific and far-sighted plan, such as might be developed by a central body capable of studying the pursuit of war and its consequences *as a whole.*

Not the least important function of such a body would be to reflect on the future—to consider what our condition will be when the war is over and we attempt once more to resume our normal life. We are aware that some people resent even the contemplation of this period, fearing apparently that by so doing we in some way weaken our capacity for present effort. We can only say that this disinclination to look ahead is characteristic of the weaknesses which revealed themselves in our past mental attitude but which, we hope and believe, we shall now take steps to remedy.

To a large section of the community there falls the duty of conducting the war in the field of battle; to others the equally important task of providing the combatants with the implements of warfare. But there are others whose gifts cannot be applied in any efficient manner to the actual fighting who could nevertheless render good service by making preparations for the future.

One vital problem for the consideration of such a General Staff would be the conditions of industries which are a vital asset to our national wealth and which must be safeguarded against permanent injury through the demand for men and interference with business organisation existing at the present time. To our mind an important principle to be kept in view in such cases is *the preservation of continuity.* It is inevitable that industries should suffer, but the weakening should not be carried to the point of exhaustion, and a framework for future effort and expansion should remain in being. This principle applies not only to commercial undertakings but to scientific, educational and technical organisations which act as originators of ideas, and stimulate industrial and national enterprise. Such institutions might, with proper guidance, do much to prepare the ground for the future—to pursue the deliberations which, as we have seen, are a necessary preliminary to future organisation.

Admittedly the coming of war found us in a large measure unprepared. Let us see to it that in the time to come we are not found even less prepared for peace.

Light and the Human Machine.

Machinery is of two kinds—human and mechanical. The last century saw the development of mechanical machinery to a high state of complexity and perfection, and requiring considerate treatment. Every engineer is aware that machinery which is left idle may suffer more than if in constant use and properly looked after; and conversely, that machines must be "nursed"—guarded against strain, improper use, and application to work beyond their power.

Far-sighted employers also appreciate the need for keeping their human machinery in good condition, as is shown by the improved hygienic conditions in the factory and the opportunities frequently provided for refreshment, recreation, and medical attention on the premises.

At the present time, when many factories are working long hours at great pressure, these facts should not be forgotten. There is sometimes a tendency to work a willing horse too hard and to omit proper intervals for recuperation. Physiologists have shown that, up to a certain point, the body can recover from fatigue; but if the effort is too severe or too persistent there may be permanent chemical and physiological changes which destroy to a greater or less degree the power of recuperation and prevent complete recovery.

The scientific researches of the late Frederic Winslow Taylor in the United States have shed a great deal of light on this problem, showing, in many instances, how by judicious intervals for recreation the day's output of work can be substantially increased and the efficiency of the human machine safeguarded against the results of excessive strain.

Especially should we consider the effect of the conditions of labour on the performance of work. In an article in the present number (pp. 335—338) some instances are given of the effect of improved illumination on the quality of work and output. We have frequently alluded to this point in the ILLUMINATING ENGINEER, and the great advance in factory lighting during recent years in itself shows that the manufacturer is becoming alive to the relation between light and work. Mechanical machinery, it is well known, suffers if the illumination is insufficient. Its parts cannot be seen and do not get properly cleaned; its efficiency is diminished and its rate of deterioration is increased. In the same way the human machine can only do its best when proper light is provided.

It is well known that this subject has been receiving the attention of a Departmental Committee appointed by the Home Secretary during the past two years and a recent editorial in the *Electrical World* draws attention to the efforts being made by various States in America to insert in their legislation some requirements regarding factory lighting. It is remarked:—

> There seems therefore to be a wide field for the illuminating engineer in the assistance he can render where legislation of this kind is pending, and at the same time it seems apparent that the average factory owner will see for himself the many advantages of good light which, when properly viewed, form an influence almost as great as if not in excess of that normally brought to bear by legal requirements.

We are sure that when the Report of the Departmental Committee on Factory Lighting is issued it will be seen that full advantage has been taken of the experience of the illuminating engineer; and we are equally confident that any proposals which have in view the improvement of industrial lighting will be sympathetically received as a distinct economic advance by factory owners in this country.

The Lighting of the Panama-Pacific Exhibition.

In our last issue we dealt with an article recently published by Mr. W. D'A. Ryan on the Lighting of the Panama-Pacific Exhibition, now being held in San Francisco.

In such times as these it is curious to reflect that in San Francisco representatives of different nations are presumably still meeting together, and possibly even discussing the war in a more or less amicable manner. Equally remote from our present thoughts is the gorgeous and spectacular illumination which forms such a striking feature at the Exhibition. During the past few months we have become used to the diminished illumination of London and the vigorous suppression of all illuminated signs and spectacular devices. Many months may elapse before we can again turn our thoughts in this direction. But the methods employed in San Francisco appear to be so novel and interesting that they should not be overlooked by illuminating engineers even at the present time.

There have been many national and international Exhibitions during recent years, but the methods of illumination have been substantially the same; generally speaking they have shown little originality. The practice almost invariably followed has been to follow the outlines of the buildings with incandescent lamps, and the lighting in the grounds of the exhibition has differed little from which may be seen in any brightly-lighted thoroughfare. At the Panama-Pacific Exhibition special efforts were made to treat the illumination in a more novel and scientific manner. At an early stage in the proceedings Mr. Ryan and his assistants were planning the arrangements in co-operation with the commission of architects concerned in the building. The architectural plans and the lighting methods were worked out simultaneously and the whole scheme of illumination was contrived with a view to showing off the exteriors of the buildings to the best advantage by night.

The dominating feature of the lighting appears to be the illumination of the exterior of buildings by " concealed " methods. Instead of festoons of unscreened incandescent lamps the sources of light were arranged on artistic columns shaded by specially designed screens, carrying heraldic and other devices, and arranged to throw the light on to the face of the buildings. Considerable use is also made of batteries of searchlights, playing on the spires and domes of the buildings, the surfaces of which were in some cases specially designed to produce jewel-like effects. For the interior lighting use has also been made of indirect methods, such as lamps concealed in bowls and pedestal fittings, columns of fluted glass, and playing fountains. In many instances the lighting has been designed to symbolise the sentiments associated with the various Courts in the Exhibition (Court of Abundance, Court of the Universe, &c.).

It is difficult for those who have not had the pleasure of being present at the Exhibition to judge of the effects produced, but it would appear that a new precedent in exhibition lighting has been established and that the arrangements in San Francisco will furnish us with some useful suggestions when we in this country are once more able to devote our attention to decorative lighting.

LEON GASTER.

TECHNICAL SECTION.

The Editor while not soliciting contributions, is willing to consider the publication of original articles submitted to him, or letters intended for inclusion in the correspondence columns of "The Illuminating Engineer."

The Editor does not necessarily identify himself with the opinions expressed by his contributors.

LIGHT AND THE HUMAN MACHINE.

BY AN ENGINEERING CORRESPONDENT.

Among the strongest considerations that can be urged in favour of good industrial illumination is the fact that light is a *tool*, as necessary to the carrying out of successful work as the actual machine which the operator employs. Neglect to utilise this tool to the best advantage may lead to unsatisfactory results in several ways.

In the first place we find a general recognition that neglect to provide a certain measure of illumination is conducive to accidents. In view of the many complex factors entering into this problem a statistical inquiry into the relation existing between illumination and accidents is by no means easy. Nevertheless in past issues of THE ILLUMINATING ENGINEER many data have been published which suggest that such a connection exists. One of the best known instances of such statistics is the well known chart derived from statistics prepared by the Fidelity and Casualty Company of New York, showing that the frequency of accidents in the dark winter months is considerably greater than in the summer; the curve in fact follows very closely the curve showing the proportion of daylight and darkness throughout the year.

Naturally a distinction must be drawn between the conditions in various classes of employment. For example some data were given about a year ago on the conditions of employment in the iron and steel industry in the United States.* From these it appeared that in blast furnace work the frequency of accidents is practically the same by day and by night. But in the yards there are actually *twice* as many accidents at night as there are during the daytime. This is to be expected, for in the yards unskilled labour, for which very little artificial light is provided, is mainly employed, and the risk of accident through men falling and stumbling in such cases is proportionately greater. It is however highly probable that many other accidents, such as those arising from neglect of machinery, might be traced to defects of lighting. Mr. R. E. Simpson, in a recent paper before the Illuminating Engineering Society in the United States,† mentions an interesting incident:—

> "The following incident which recently came to the writer's attention, illustrates the evils of "spotted illumination" and the danger to workmen if one of their number was afflicted with retinal asthenopia or temporary blindness, and shows how easy it is to overlook the real cause of an accident.
>
> "Two men were at work in a shop lighted by electric incandescent lamps, equipped with obsolete tin reflectors

* *American Industries*, May, 1914.

† Trans. Ill. Eng. Soc., U.S.A., Vol IX., No. 5, 1914.

suspended close to the work. The upper zone of the shop was in semi-darkness—a condition which became more pronounced to the workmen as they looked up from their work. Some sections of the machinery and floor were brightly lighted, while others were dim. In going to another part of the shop one of the men stumbled over a casting that was lying on the floor, and in an effort to save himself from falling he blindly put his hand on a belt-shifting rod which controlled the machine of another workman in the same row. This action threw over the belt and started the other machine. Fortunately no injury resulted, as the second workman had just finished a piece of work, and was engaged at the time in selecting another piece to put in his machine. It can readily be seen that a serious accident might have happened if the second workman had been engaged in adjusting the work in his machine as he would have been totally unprepared for the starting of the machine.

"The two men had a wordy war, the first workman blaming the man who had left the casting on the floor, while the second workman accused the first one of stupidity. Neither of them apparently considered the fact that the first workman was demanding an extraordinary performance from his eyes. There was marked difference in the reflecting values of the two parts of the castings on which he had been working. One part was highly polished and had a high coefficient of reflection, while the other part was a dull iron grey having a low reflecting value. The man's eye muscles had been under constant strain in an effort to adjust the pupilary opening to the light-reflecting conditions—the opening remaining relatively small, however, so long as the eyes were focused on the work. When he turned from his machine his eyes were compelled to adjust themselves to the change from a brightly lighted field of view to a dimly lighted one, and inasmuch as the eye muscles do not enlarge the pupilary opening as quickly as they contract it, he was labouring, for a time, under a serious handicap.

"If the incident had had a serious ending, the newspapers would have reported the accident as due to a fellow workman accidentally moving a belt shifter and thus starting up his comrade's machine; but an impartial and well-informed jury would have given improper illumination as the cause."

To many people this may appear a trivial incident but doubtless it is by no means an isolated case. In almost every branch of factory work there are opportunities for accidents and the freedom from such is largely a matter of chance.

Most of those who have studied factory lighting have been impressed by the need of drawing distinction between the illumination required for the purpose of carrying on special processes (which varies naturally according to the character of the work) and the necessity for providing a general standard as a measure of safety. Attempts have been made to draw conclusions from practical experiences as to the order of illumination required from the latter standpoint. It may be noticed, for example, that in the discussion on the Lighting of Railways, which took place before the Illuminating Engineering Society in this country at the end of 1911, Mr. Haydn T. Harrison pointed out that on most railway platforms a minimum illumination of 0.25 f.c. was considered desirable—and this was borne out by figures presented by others with regard to the prevailing illumination on the platforms in the Tubes. Mr. Harrison also pointed out that in the lighting of goods yards an illumination below 0.25 f.c. causes delay in the handling of the goods, although, strictly speaking, this degree of illumination is only necessary at the points where they are being handled; similarly in shunting yards a minimum horizontal illumination of 0.1 f.c. was suggested as practicable.

Curiously enough the above value—0.25 f.c.—is very close to that suggested by Mr. R. E. Simpson as desirable in the interests of safety. In this connection he remarks:—

"From a safety standpoint as well as from a general illuminating engineering standpoint, intense local lighting,

as the sole means of providing artificial illumination in a factory, is undesirable. A minimum of two-tenths of a foot-candle should be provided in all parts of a factory where a moderate degree of local illumination is required. In plants where fine tool-work is done, and fine bench operations are carried on, so that intense local lighting is required, the minimum for general lighting should be one-half a foot-candle. This minimum is also essential in a shop filled with moving machinery, especially if the men are required to go from one part of the shop to another in the performance of their duties. Sharp contrasts between the intense local illumination and the low general illumination increase the hazards, because the employees, on account of their inability to see clearly, are apt to trip over obstructions in their path, or become caught in the machines or belts."

Naturally the illumination required for the purpose of carrying out work, as distinct from that needed from the standpoint of safety, varies much in the different industries. But in all cases the value provided for carrying out the work is very much above the safety minimum, of 0·2—0·5 ft.-candles, tentatively suggested by Mr. Simpson.

For example, the following figures were suggested by Mr. C. L. Eshleman* as typical of present practice in various factories :—

	Illumination (f.t-candles).
Carpenter's Shop :—	
General	2·5
Machinery	4·0
Corridors	0·6
Drafting Room	8·0
Engraving	10·0
Factory :—	
General lighting (where individual drop lights are provided)	1·5
General lighting (where no individual lights are provided)	4·0
Local bench illumination..	4·0
Mechanical work (fine) ..	5·5
Pattern Shops	4·0
Sewing :—	
Light goods	4·0
Dark goods	8·0
Spinning mills	2·0
Typesetting	8·0
Warehouses	1·0
Wharves	1·0

* Proc. Amer. Inst. of Elec. Eng., Jan. 1913.

It cannot be gainsaid that the lighting of open yards is an exceptionally difficult problem. The same applies to ships. In the ship building trade, Mr. Simpson remarks, a large percentage of the accidents that occur are caused by falls, and the lack of proper lighting facilities is an important factor. "When a ship is building or being repaired, artificial lighting must be depended on, all the time, in almost every part of the ship. Generally speaking, adequate light is provided at the points where work is performed, but the lighting facilities from the working point through the ship to the shore are often neglected. The opportunities for falls are numerous, especially when the ship is being fitted out after launching. Open hatches, uncompleted and unguarded stairways, and gangways seldom, if ever, sufficiently lighted, are directly responsible for many serious and fatal injuries. If ship owners or builders would go to the slight expense of providing guard rails about stairways, platforms, bunker hatches, and openings into the hold, and see that these points are well lighted, the accident rate would be materially reduced.

Liability to accidents, however, is only one of the ills caused by insufficient industrial illumination. In a report presented by a Committee on Industrial Pathology appointed by the Royal Society of Arts as far back as 1885, Mr. White-Cooper, surgeon to St. Mary's Hospital, remarked that :—

"The vigour and energy with which work would be carried on in cool, well-lighted, well-ventilated apartments, would satisfactorily prove that attention to such points would be as conducive to the interests of the employer as to the health and comfort of the employed."

Some of the highly scientific researches on labour in factories carried out in the United States have shown that minute changes in practice may give rise to surprising improvements in output. At the present time, when many of our

factories are working at great pressure the importance of this special field of study is well worth attention. We have yet to see in this country an exhaustive investigation of the part played by fatigue in limiting the efforts of workers. Physicians tell us that unduly overlong work at high pressure is uneconomical, and that better results could even be secured by allowing intervals for recuperation: in other words that *it is actually possible to work longer and accomplish less.*

Probably this applies particularly to highly skilled labour. If a workman is engaged on operations which require the utmost concentration of mind it is obviously desirable that his faculties should be at their keenest. One can easily understand how in these circumstances relatively small defects in the lighting arrangements will cause delay. Insufficiency of illumination, an inconvenient shadow, or a slight dazzling effect produced by reflection of light from a polished surface—all these causes may lead to a slip on the workman's part, or at least make him hesitate and lose time. If this is true how much greater must be the strain of attempting to carry out fine work and to make measurements to a small fraction of an inch, when the illumination is obviously inadequate. The illumination, therefore, should be regarded as an essential part of the machinery.

From the economical standpoint this view can be fully justified. It can be shown, for example, that in most cases the amount spent on lighting is a minute fraction of the cost of the machinery and the workmen's wages. Mr. C. L. Eshleman* mentions that in a large paper mill in the United States the loss on the output for 6 minutes is more than the cost of the lighting for 24 hours, the question of the cost of light is thus inconsiderable as compared with the efficiency of the workman. "Even if used during the entire working hours of the day, it will not represent more than one-half of one per cent. of the workman's wages."

Mr. Eshleman also gives some personal experiences on this point:—

"After leaving college, the writer entered the shop course of one of the large electrical manufacturers. Daylight conditions in the factory were good, but the artificial lighting was not at all conducive to human efficiency. Winding coils on piece work basis he could earn $2.00 per day. Later when changed to night shift, he could earn only $1.10 during a corresponding number of hours. The same condition held with other men, so that we requested to be placed on hourly pay. We did not think about efficiency engineering of light at that time and apparently the foreman did not, because there was no change, and the company continued to run that department at 55 per cent. efficiency. In addition to that, it is recalled that only about 5 per cent. of the coils wound by daylight failed under high-voltage insulation test; while 10 to 15 per cent. of those wound at night were returned for rewinding."

There is no doubt that the influence of lighting is beginning to be realised by workers of the present generation, and that this alone will compel manufacturers to consider this point.

Mr. Franklin Thorpe, in his paper before the National Gas Congress in 1913, mentioned cases of weavers leaving one firm to go to another simply because of the lighting, and in one or two cases a strike was only diverted by hurrying on the lighting arrangements! Mr. Thorpe likewise contends that the cost of lighting is usually a small portion of the wages. For example in one instance the lighting costs are only .2 per cent. of the wages bill; the Insurance Act proposition in this mill worked out to 0.36 per cent.—nearly double the lighting costs.

This corroborative evidence of the value of good industrial lighting has a special bearing on the conditions in factories at the present moment.

Two points are being brought prominently before the public mind, the need for constant and energetic work to maintain the export trade of the country and provide munitions of war; and the necessity for thrift so as to avoid useless expenditure. But by "thrift" we do not understand parsimony in the provision of tools. The wise manufacturer will recognise that proper illumination, itself an important "tool," by facilitating the carrying on of work, pays for itself over and over again.

* *loc. cit.*

SOME EXAMPLES OF MODERN FACTORY LIGHTING BY GAS.

Readers will recall that in our May issue, an account was given of a recent paper by Mr. A. E. Broadberry, of Tottenham, on Factory Lighting, in which a number of modern high pressure gas lighting installations were described and illustrated.

FIG. 1.—Showing the lighting by low pressure gas of a small workshop. Four 3-light units are used, the light from the inverted mantles being concentrated downwards by appropriate enamelled shades.

We now give a few additional examples of gaslighted factories. Fig. 1 is interesting as an example of up-to-date low pressure lighting in a small workshop. The dimensions of this room are 30 ft. 6 in. by 31 ft., and it is lighted entirely by four 3-light units, each of which consumes approx. 15 cubic feet of gas per hour. The illumination of the benches in the centre of the room was determined instrumentally, readings from 5·7 to 10·5 ft.-candles being obtained. (These values agreed very closely to those calculated from the polar curves of the lighting units.) The reflectors are very serviceable in concentrating the light on the benches in the centre of the room, but at the same time there is a good illumination on the walls and blackboard. The photograph gives a good idea of the appearance of the room, and suggests that these illumination values, besides being considerably above what is necessary in the interests of safety, amply suffice for the work in hand. For these particulars, which are probably typical of many small workshops of this size, we are indebted to the courtesy of The Gas Light and Coke Co.

Figs. 2—4 refer to some low pressure installations in the district of the South Metropolitan Gas Co., to whom we are indebted for the photographs and data relating thereto. Fig. 2 is a view of a portion of the factory of Messrs. Jay's at Southwark, where a worker is seen at the machine table operating in straw. Near the machine is shown a Martens photometer used for measuring the illumination, which was found to be near 6 foot-candles. The worker was questioned as to the sufficiency of this illumination, and stated that it was ample for work on grey and black straw. In the gangway and staircase adjacent to this part of the room readings of 0·6 and 0·53 foot-candles respectively were measured at a height of 18 ins. above the floor—a figure which now probably may be considered quite sufficient from the standpoint of general convenience and safety in places where work is not actually in progress.

Fig. 3 shows a bench devoted to machine work in the same factory. Attention may be drawn to the row of pendant lamps, each equipped with a reflector concentrating the light on the bench.

Fig. 4 shows a common method of lighting staircases. In many factories there are stairways which receive little, if any, daylight, and from the standpoint of safety it is important that some appropriate artificial illumination should be available in such cases.

The other two illustrations show the Napier Motor Works, which are lighted with Keith high pressure gas lamps. The photographs are taken from the same position, by daylight and high pressure gas respectively. Such comparisons are useful with a view to bringing out any differences in the arrangement of shadows, &c.; in this case there does not seem to be any very radical difference in this respect.

FIG. 4.—Staircase and landing lighting.

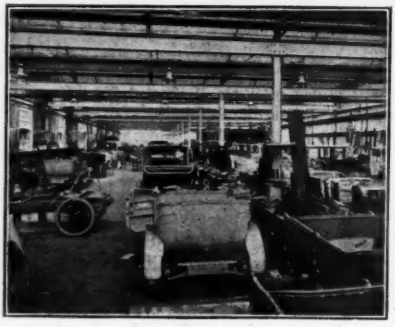


FIG. 5.—By daylight.

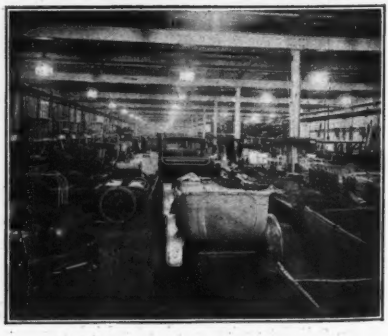
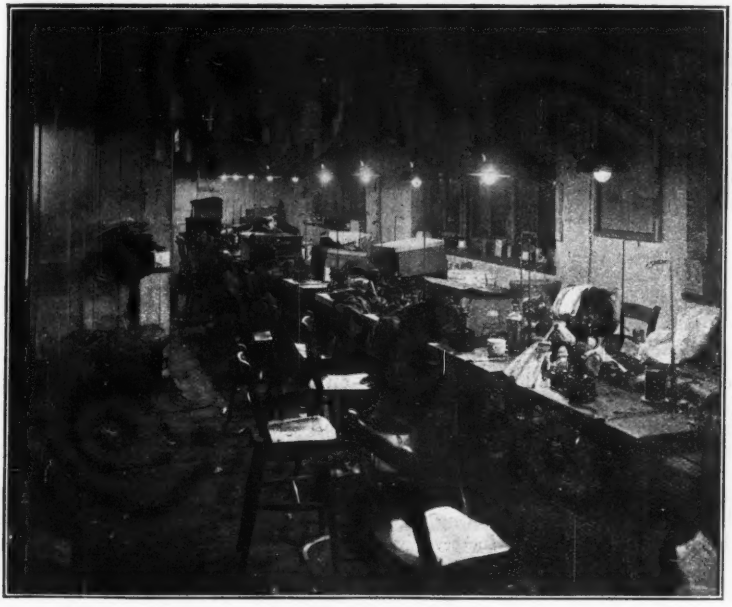


FIG. 6.—By artificial light (Keith high pressure gas lamps).

Showing lighting conditions in the Napier Motor Works.



FIGS. 2 & 3.—Lighting of benches devoted to straw and sewing work at Messrs. Jay's Factory, Southwark.

Our last illustration, Fig. 7, shows a general view of a section of a factory of the Anglo-Swiss Nestle's Condensed Milk Co. The main lighting here is accomplished by 1,000 candle-power high pressure Keith lamps, situated at a height of 14 ft. 6 in. above the floor; small lamps giving 120 candle-power are to be seen in one of the rooms on the left of the illustration.

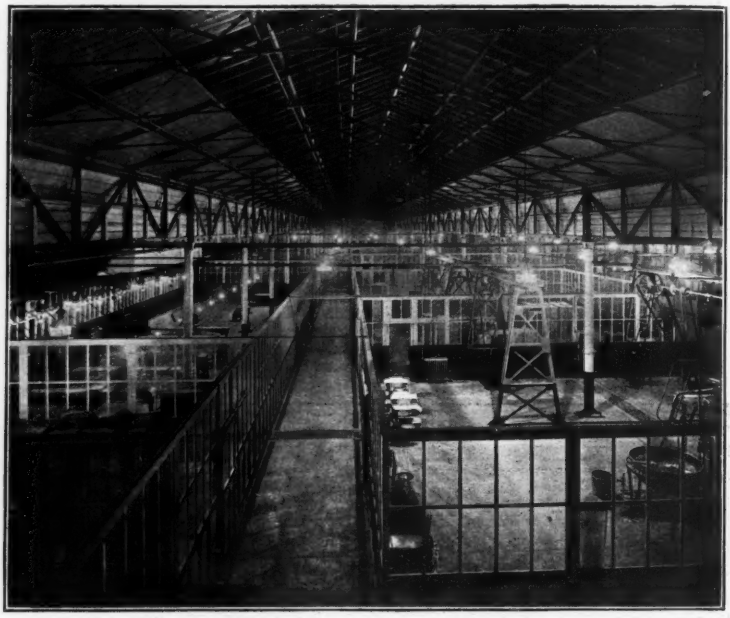


FIG. 7.—A view of the factory of the Anglo-Swiss Nestle's Condensed Milk Co., Battersea, lighted by Keith high pressure 1000-c.p. gas units.

The nature of this interior is interesting as showing how powerful lamps placed high up can be arranged to give a satisfactory general illumination, in spite of the presence of girders, belting, &c., which are apt to cause inconvenient shadows. The following figures are given for the illumination of this factory:—

On the floor values in the neighbourhood of 2 ft.-candles were measured. Considerably higher figures were obtained at the various points where work is done. For example, at the mixer (edge of pan), 3·7 ft.-candles; on the feed and receiving ends of enrouver, 3·5 and 5·5 ft.-candles; on the packing bench, 3·2—4·5 ft.-candles. These values, we understand, are considered ample from the standpoint of carrying on work, and the illumination on the floor level is probably a generous estimate of what is needed for general convenience in moving to and fro.

It will be observed that the 1000 candle-power are here used without globes, and merely surrounded by screens made of plate glass. In these circumstances the cost of maintenance is considerably reduced owing to the avoidance of globe breakages; there is also the additional advantage that if any plate breaks it can be easily and inexpensively replaced.

OVERHEAD SHOP LIGHTING.

The problem of lighting a large engineering factory is an important one at the present moment. The accompanying illustration shows the application of the overhead system of lighting in a large erecting shop. Lamps in focusing reflectors are spaced above the cranes, leaving a completely clear shop and reflector and judicious spacing of the units.

The shop shown is 160 ft. long, 63 ft. wide, and 36 ft. high. There are 12 focusing reflectors, each containing a 400-watt lamp, arranged in two rows of six, and suspended approximately 33 ft. from the ground and above the cranes. The total consumption of electricity is thus

FIG. 1.—Overhead electric lighting in an erecting shop.

avoiding all the inconveniences of hanging pendants, &c. From the illuminating engineering standpoint it is also a distinct advantage to have the lamps high up out of the field of view, the inconvenience of glare being practically eliminated. In these circumstances it is usually desirable to flood the shop with an even, well-diffused lighting; success in this respect, and also in securing high efficiency, demands careful attention to the type of 4,800 watts, which is equivalent to rather less than half a watt per square foot of floor area. The illumination on the lighting plane is given as 2.2 foot-candles —quite a high value for this consumption of electricity—and is said to be extremely even.

For this photograph and information relating thereto we are indebted to the courtesy of the British Thomson-Houston Co., Ltd.

INDUSTRIAL LIGHTING BY MERCURY VAPOUR LAMPS.

FIG. 1—By daylight.

FIG. 2.—By artificial light.

Conditions of illumination in a Streatham workshop devoted to sewing.

It is generally agreed that one of the most important factors in good industrial lighting is the arrangement of shadows. In this respect, probably, artificial light is almost invariably inferior to daylight, and it may be that unduly sharp shadows occasionally lead to accidents. It would be most interesting to obtain for typical factories a series of photographs comparing the conditions by natural and artificial light. We should then see in some cases how inconvenient shadows and contrasts exist which hamper the efforts of the workman and tend to slow down the speed of execution; in other cases, it is possible that artificial light, wisely arranged, might actually give better results than are obtainable with daylight.

The above two photographs, showing the illumination of a sewing room respectively by daylight and by Cooper-Hewitt lamps, are interesting in this respect The fact of the light being diffused over such a wide area in these lamps naturally gives rise to soft shadows, and this effect is well illustrated in the photograph of

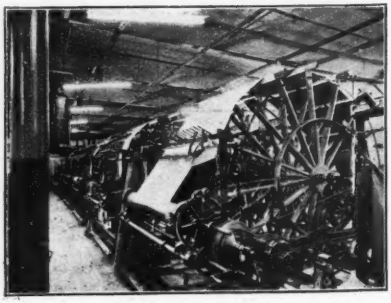


FIG. 3.—Silk mill illuminated by Cooper-Hewitt Lamps.

the silk mill shown in Fig. 3. The advantages of well diffused illumination are particularly evident in the case of complicated and intricate machinery, where

abrupt shadow-contrasts interfere with the inspection of parts.

On the other hand it must be recognised that in certain industries, especially those involving highly skilled "fine" work; general illumination, however well arranged, might be regarded by the operators as insufficient. In such trades as watch-making, jewellery, and metal work, fine sewing, &c., the worker almost invariably prefers a local light which he can adjust and adapt to his requirements, and it is recognised that in these cases some degree of local lighting in addition to general lighting is often desirable.

SPECIAL PROBLEMS IN RAILWAY LIGHTING.

The lighting of railway stations, including platforms, goods yards, &c., was discussed at a meeting of the Illuminating Engineering Society about three years ago.* Engineers who are not railway men perhaps hardly realise the number of special lighting problems met with on a large railway, the conditions of illumination being often determined by considerations which would hardly occur to outsiders.

A special case in point is furnished by the lighting of "track scales and yards," which formed the subject of a recent paper before the American Illuminating Engineering Society by H. Kirschberg and A.C. Cotton.† The main source of revenue of most large railways consists in freight haulage, the carrying of passengers being as a rule a subsidiary source of income.

The method by which the weight of the goods passing over the line is registered, and the income from various sections of freight haulage estimated, is quite interesting. When a train of cars is made up, the cars are passed over a special section of the line termed the track scale, which may be from 37—83 feet in length, and of 300,000 lbs. capacity. This is built on a concrete foundation and communicates by means of levers to the scale beam in the small adjacent office built outside the section of the line, which is called the "scale-house."

The line approaching the track scale has a slight gradient, and each car is in turn allowed to run by gravity from the scale to the classification yard. As the car passes over the scale at a speed of 2·5 miles per hour the weighing is done. The operator in the scale house notes the indication of the beam before him and at the same time can look out through the window and observe any necessary particulars of the cars as they are passing.

* *Illum. Eng.*, Jan. 1912.

† Trans. Illum. Eng. Soc., U S.A., Vol. IX., No. 3, 1914.

The lighting must enable him to carry out both these sections of his work. The scale beam immediately before him should be illuminated by local lamps completely screened from the eye. The illumination must be sufficient for the figures on the beam to be read with ease, but there must be nothing in the arrangements of these lamps which would dazzle the operator's eyes and interfere with his view through the window of the cars outside. Seeing that he has to gaze out into comparative darkness it would probably be better for the room not to be completely lighted, merely enough illumination being provided to see the figures on the beam. The lighting of the track scale itself requires to be considerably higher than that used for ordinary track lighting, and in the illustration shown by the authors several special lamps are shown immediately under the projecting roof of the scale house so as to illuminate the track strongly and yet be screened from the eyes of the weighmaster inside the house. As the latter is looking from an illuminated room into a less brightly lighted area outside the lamps used to illuminate the track should, if possible, be screened so as not to interfere by their brilliancy with this view of the cars. Similarly these lights (and also any interior lights visible through the windows) should be so arranged that they do not dazzle the workers on the hump and clearance grades, as this might result in possible accidents to riders and car-cutters.

The functions of the illumination outside the scale-house are summarised as follows :—

Safe cutting of cars at the hump.

Location of car at every point in its movement.

Clear sight of movement of every wheel on to the scale.

Reading of light weights and numbers on ends of approaching cars.

Reading of these weights and numbers on side of car on scale. (For this work a clearance of 2 ft. 11.5 in. (0.90 m.) is all that is allowed).

Reading of the light weights and numbers of the receding end of car, if not procured during either of the two aforementioned intervals.

Movement of the wheels off the scale.

Clear sight of movement of car down the clearance grade in order to safely pass the next car over the scale.

Location of position of car on the clearance grade in order not to bump cars too hard when making up drafts of cars to go down the classification yard.

In the "classification yard," which is used for the purpose of connecting freight cars into particular routes and destinations, the usual method of lighting is to have a line of lamps down the centre of the yard and a line in each side. It is considered an extremely difficult problem to light a yard of this kind satisfactorily. It is not strictly speaking an ordinary open space and there are opportunities for special local lighting at various points, such as illumination of the switches at the head of the yard to facilitate the control of car movements from the switch tower.

THE PHOTOGRAPHIC VALUE OF VARIOUS ILLUMINANTS.

With further reference to the article in the July issue of THE ILLUMINATING ENGINEER on The Use of Light in Cinematograph work, it is of interest to note that Dr. L. Bloch has recently been carrying out a series of tests of the "actinic power" of various illuminants. He takes as his unit—the "phot"—the photographic effect (on silver chloride and bromide emulsion) caused by the Hefner lamp at a distance of one metre. On this basis the actinic values work out as follows :—

Source of Light.	Volts.	Amps.	Watts	Candle-power (H.K.).	Actinic effect. (Phot.)	Phot. Watt.
Hefner Lamp	—	—	(86·3)	1	1	0·0116
10 H.K. Tungsten Lamp	14·2	0·68	9·65	10	46·4	4·72
Gas-filled "Nitra" Lamp	110	4·5	495	1230	8850	17·88
Arc Lamp with inclined carbons ..	88	9·0	792	1880	44,300	55·9
" " " ..	90	12·4	1016	2690	64,800	63·8
" " " ..	92	13·1	1207	3450	73,300	60·7
220 V. Enclosed Arc	112	4·4	492·8	137	65,530	135·7
" " "	115	7·12	818	292	202,400	247·5
" " "	116	9·32	1081	1888	243,000	224·8
Quartz Mercury Vapour Lamp (1·5 amp.)	36	4·1	147·6	21	6,940	47·0
" " " "						
" " " "	62	3·4	210·8	30	15,640	74·2
" " " "	90	2·8	252·0	60	28,350	112·5
" " " "	137	1·78	243·8	280	51,000	209·3
" " " "	146	1·61	235·0	375	25,550	108·8
" " " "	150	1·55	232·0	450	20,800	87·6

It is interesting to note how very greatly the actinic value of the enclosed arc lamp increases as the power given to the lamp is increased.

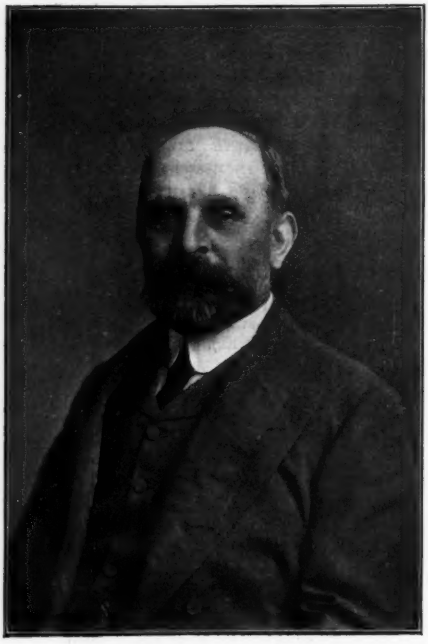
In the quartz tube mercury vapour lamp a rather curious state of affairs appears to exist. The first effect of increased power given to the lamp is to make the actinic value very much greater. But a maximum in this respect is ultimately reached, and the actinic effect begins to diminish. This seems to correspond with a change in the spectrum of the light. The first effect of increasing the power is to make the mercury line spectrum more powerful. But afterwards as the quartz tube heats up and becomes incandescent, the line spectrum is partly replaced by a continuous spectrum. It would seem therefore as though part of the actinic energy were converted into visible light, and the higher luminous efficiency were gained at the expense of actinic effect. If confirmed, this is an important result, and suggests that for photographic purposes the pressure applied to the lamp should be somewhat less than that necessary to get the best luminous effect.

PUBLIC LIGHTING IN WESTMINSTER.

In the *Gas World* particulars are given of a new arrangement to be made between the Gas Light and Coke Co. and the Westminster City Council. The expiring contract is to run until Nov. 15th, after which the standard of light in all or any number of the units may be reduced by two-thirds, and new charges for the reduced units submitted. The Council, however, will have power to revert to the old conditions as regards minimum candle-power at any time. The clauses with regard to testing of candle-power will remain suspended until one month after the removal of the present restrictions on public lighting.

EDWARD ALLEN.

BORN 1850; DIED 1915.



IT is with great regret that we record the death of Mr. Edward Allen, Chief Engineer of the Liverpool Gas Company, on Thursday, July 15th. Mr. Allen held an important position in the gas industry. Born in Liverpool in 1850, he early entered the services of the Liverpool Gas Company, eventually becoming Chief Engineer in 1904. In 1914 he reached his fiftieth year of service with the company—an event which was recognised by presentations by the Council and staff, with whom his relations were always of a most friendly character. He occupied the Presidential chair of the Institution of Gas Engineers in the important year 1913, when the National Gas Congress and Exhibition was held at Shepherd's Bush in celebration of the Centenary of Gas-lighting.

Besides being responsible for many technical advances in connection with gas Mr. Allen took a keen interest in the wider aspects of the application of science to industry, and the development of technical education. Shortly after the outbreak of the war, his services were accepted by the High Explosives Committee, where his professional knowledge was of considerable value.

As a Vice-President of the Illuminating Engineering Society Mr. Allen was in close touch with matters of illumination. He also represented the Institution of Gas Engineers on the National Illumination Committee of Great Britain, and was its first chairman. Only last January he presented the Annual Report of the proceedings.

Mr. Allen was a strong believer in co-operation. Although so prominently identified with gas his inherent fair-mindedness enabled him to make many warm friends in the electrical industry. He frequently expressed the view that there were openings for all illuminants, and that all could co-operate in educating the public to appreciate the value of good lighting; we have a vivid recollection of his genial speech to this effect, when replying to the toast of "Kindred Societies" at the Annual Dinner of the Illuminating Engineering Society two years ago.

In his dealings with colleagues and assistants Mr. Allen invariably displayed great tact and sympathy. All those who came in contact with him appreciated his lovable and kindly disposition, and his loss will be regretted by a wide circle of friends.

THE APPLICATION OF EDUCATIONAL METHODS TO THE REDUCTION OF ACCIDENTS.

By SYDNEY W. ASHE

(General Electric Company, Pittsfield, Mass., U.S.A.).

Presented at The National Association of Corporation Schools' Convention, June 9th–12th, 1914

The practical application of the teachings of psychology to accident prevention is after all the surest and quickest way of curing this industrial evil which in 1911 in this country exacted a toll of 13,625 lives. These deaths coupled with other injuries to persons represent an annual waste, according to conservative estimates of the American Red Cross, of at least $250,000,000. This large sum does not include millions paid out in damage suits, surgical care, loss of wages or the subsequent decrease in efficiency of the injured.

Many companies in America in instituting safety work have followed implicitly the methods used with such success in foreign countries, such as Germany, in guarding all points of danger, hoping by this means to obtain equal success. Not realizing the fact that in a country like Germany, with its military training, its similarity of population, its sureness and thoroughness of operations of the workingmen, its systematization, that conditions were entirely different from what they are in this country, they have not been able to obtain the same measure of success. This point is well illustrated by the following abstract from Technical Paper No. 30 of the Department of Interior, Bureau of Mines by Dwight E. Woodbridge on "Mine Accident Prevention at Lake Superior Iron Mines."

EFFECT OF SAFETY PRECAUTIONS ON NUMBER OF ACCIDENTS.

"Although it is quite probable that present standards would demand a larger number of safety devices than in the past, and would require the company to exercise more care than formerly, one must still conclude that the installation of these devices, while of undoubted importance, does not reduce the number of accidents to the extent commonly supposed. There are other elements that must be given the most careful consideration. Of these, the chief is the education of the working-men to a sense of interdependence and individual responsibility."

Mr. Robert J. Young, Chief of the Safety Department of the Illinois Steel Company quotes as follows in connection with the value of educational methods for accident reduction.

"The question has been asked as to what efficiency in accident reduction can be acquired by guarding dangerous places. After going into the matter very carefully, I am led to believe that not more than 33⅓ per cent. of efficiency, can be gained by guarding machines, and in connection with this you will have the incidental advertising of safety that comes with the installation of the guards. Usually this efficiency will fall below 25 per cent.

"In talking with the United States Government expert in accident prevention, I asked this question. He placed the guarding of machines (not taking into consideration the incidental advertising of safety thereby) at not greater than 10 per cent. You will see, therefore, that if you are going to make a material reduction in your accident rate, it must largely be done through inspection and education."

The First Aid Department of the American Red Cross, under the direction of Major Robert U. Patterson, U.S. Army, and his associates, has done splendid educational work along preventative lines and first aid throughout this country. A large number of classes on First Aid to the Injured have been carried on throughout this country under their

supervision. As an illustration of their progressiveness during the past six months two of their equipped First Aid cars have visited Pittsfield, Mass., the home of the writer. Their physicians have given talks.

Dr. William H. Tolman of the American Museum of Safety, with the co-operation of the Brooklyn Rapid Transit Company and the Board of Education of the city of New York, have trained thousands of school children in safety methods. If this work is started in other cities as it has been, and continued for a few years, there is no question as to the wonderful benefit which it will be to our people and to our industries as a whole.

Many of our railroads, Y.M.C.A.'s, manufacturing companies, &c., have started First Aid classes, realising the great importance of educational work along preventative lines. In carrying on educational work on accident prevention we should not lose sight of two important things. No. 1, Carrying the work on continuously, and No. 2, Necessity of repetition.

Mr. Paul Lupke, in a paper on "Safety First" last week, before the National Electric Light Association, dwelt upon this latter point in the two following important abstracts.

"Newspaper men and other publishers and writers know that the people do not learn facts and arguments on any subject by one announcement, and that it needs constant effort of iteration and reiteration to send the matter home to the people it is wished to reach."—By Professor Wm. Howard Taft.

"The greatest factor operating toward the prevention of accidents is not the prevention device but the 'prevention spirit.'"—Power.

If we all realized in safety work that each employee is a human being with a human interest, has his family and home, no matter how humble his position may be, is usually ambitious and has a natural interest in his work and in the community, reads his daily paper, &c., in other words likes to live—we would see quickly that it is possible to obtain the co-operation of this individual in developing the safety habit providing we use educational means and choose the right methods. Habits of safety instilled into the minds of working people ultimately find their way into improved quality of goods manufactured or service performed. At our local works, a large part of our output is "electrical transformers." These devices are placed in our electrical systems between the high voltage and the low voltage side. These devices not only serve to adjust electrical pressure so that it can be used in the house of the consumer for practical purposes but also act as a buffer for all disturbances from lightning and otherwise on our electrical transmission system. It is absolutely essential that this piece of apparatus be safe. It is safe and it is built to be safe for many years and one of the reasons it is safe is due to the habit of "personal safety" which is developed into the man at the bench or at the lathe who winds and builds this apparatus.

"Get the safety habit" is a good slogan, and to get this habit we must have our men accustomed to safe conditions, to using safe tools, to eliminating chances, to removing sources of danger, to be interested in having the best departmental safety record, to be willing to obey safety instructions and finally to be on the job when anything goes wrong.

Psychology teaches us that the reason loose habits are formed is that we are creatures of least resistance and choose such a path which brings the greatest momentary satisfaction. The reason a chance is taken and an accident results many times is therefore due to a mental feeling of unwillingness at this instant to use the extra effort to do what is right. To overcome this feeling of mental inertia we must therefore visualise in the individual at this particular instance a picture of the consequence of the accident if the chance is taken. To have this condition brought about, the individual about to take the chance must know of the danger and must have the safety habit. This habit can be readily developed by continuous safety educational work.

While many of the larger manufacturing and public utility companies have instituted safety measures, a number of the smaller companies have done little in this direction. In many places, dark passageways in need of efficient lighting are prevalent, besides utter lack of safety measures. Inadequate means of caring for injured and lack of safety educational work are also apparent. If these companies would only realise how much it is within

their power to accomplish in safety work with comparatively little expense, the country's yearly accident rate would be considerably reduced. Many excellent safety publications issued by various companies which they are only too glad to provide may be obtained free, which will give beginners in safety work many excellent suggestions.

Careful record of accidents, safety inspections, medical and physical inspection of new employees, and periodic inspection of old employees, emergency hospitals, first aid jars, a works paper co-operating with local daily papers and giving publicity to First Aid deeds, are all excellent adjuncts to any educational accident prevention campaign. The following synopsis gives a brief summary of a safety educational campaign which was recently instituted at the Pittsfield Works of the General Electric Company (U.S.A.), with the results which we have so far been able to obtain. Besides this work we have our Safety Committee and its chairman, who is a member of our Central Safety Committee for our entire organization. All of the educational methods used have been for the purpose of obtaining the co-operation of the working man himself, and it is gratifying to note that in this respect we have obtained a splendid response.

Outline of Synopsis.

No. 1.—A system of weekly records was instituted whereby it was possible to study the character, the magnitude and the causes of the accidents occurring. This data was tabulated, was plotted on charts for the different departments and the conditions carefully analysed.

No. 2.—Records showed that our accidents consisted mainly of eye cases, burned feet in our foundry, electric shocks, punch press accidents, injuries from protruding nails, strains and ruptures.

No. 3.—At this time we had a Safety Committee, but this committee realised, in addition, that we needed educational work and some means of reaching our people individually in safety matters. It was, therefore, decided to start a safety bulletin or works paper and institute educational methods on a rather extensive scale. Besides doing this, we used the ordinary precautions of putting on guards such as an emery wheel hood which are absolutely essential.

No. 4.—We selected from our manufacturing organisation 178 men, consisting of foremen, assistant foremen, gang bosses, &c., representing the entire manufacturing division of our plant, and these men were given occasional lectures in the company's time, on the Prone Pressure method of resuscitation, the care of shocks, the making of tourniquets, prevention and detection of tuberculosis, the use of the First Aid jar and a discussion on many forms of safeguards and causes of accidents. In 1913 we had five cases of electrical shock in which it was necessary to use artificial respiration. In each of these cases these men who were trained for emergency work acted quickly and saved the lives of the injured by the Prone Pressure method. One important case happening in our foundry made us realise how fortunate we were that we had trained our foremen in all departments. In addition to these meetings several private demonstrations were given to our girls by our trained nurse, for it was realised that it would be necessary, in case a girl was shocked, to raise the waist, cut up the corset strings, raise the corsets, before applying the Prone Pressure method.

No. 5.—While the lectures are being carried on we started a works paper, containing safety notes, surrounded with departmental notes and useful data.

No. 6.—Last winter we gave a series of lectures on experimental electricity in the evenings to our works people, having as many as a thousand present at a meeting. At each of these lectures ten minutes in the middle of the lecture was devoted to safety, covering, one evening, the use of goggles, another evening the Prone Pressure method, guarding of emery wheels, etc.

No. 7.—After a time we plotted a series of curves for the different departments, showing the ratio of accidents to employees covering such accidents as we report to the State. These curves showed the progress of certain departments, and indicated also other departments in which the rate had not been improved, such as the Order and Stores and Shipping Departments, departments that we had overlooked.

No. 8.—In the departments in which the rates were high, we divided the entire working force into groups of 30 and gave each group two illustrated safety talks, with the result that conditions immediately improved.

No. 9.—For the entire organisation we then started a form of friendly departmental competition. Each month the ratios were computed of the accidents occurring over the average number of employees. Each month a tabulation was compiled and published in our works paper showing the relative standing of the different departments. At the top of this list in black type was given those departments having a perfect record to date from the beginning of the year. Each month this list appears, and in time will, no doubt, give a very close approximation of the relative merits of the safety measures used in the individual departments. It is realised in this connection that in certain departments such as office force that the tendency for accidents is very slight.

No. 10.—Each month, when there is any special increase in the accidents in any particular department, we immediately start in giving a series of talks to the employees of this department, because it seems that every once in a while a department which has had a very good record

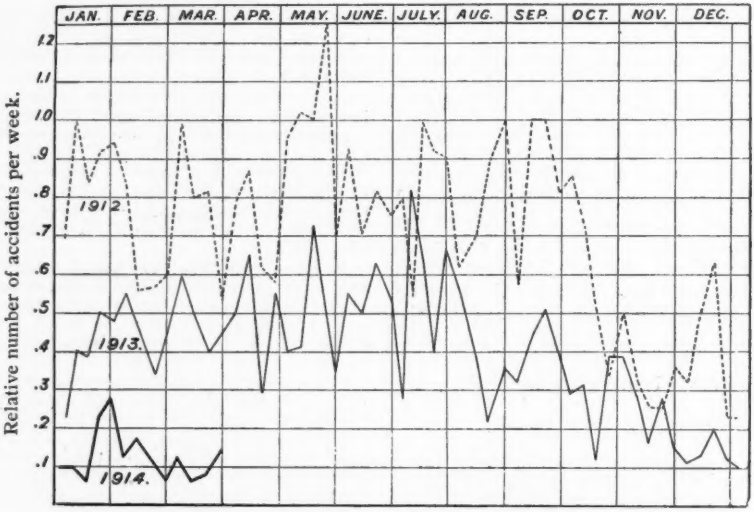
will suddenly have a very high record, and this gives an opportunity to go in and investigate. Usually there is some reason for this, such as changes in the personnel of the department, changes in the methods, and in easing up in safety precautions.

No. 11.—While the educational work was in progress the men were encouraged at the lectures to make suggestions and frank criticisms of our safety methods. Many useful ideas in connection with guards, dangerous places, &c., have been obtained in this manner from our men besides increasing the "personal safety habit."

No. 12.—Before starting a series of lectures for a given department, careful inspections were made of this department to study the particular hazards of the work; such a place as the Shipping Department, for instance, requiring different safety precautions from the Foundry. These inspections afforded an opportunity for studying carefully the hazards in the different places and enabling many changes to be made.

No. 13.—When it was found that persuasion, inspirational work and educational work did not bring about improvement in safety conditions, rigid discipline was immediately instituted, with the result that the situation was instantly improved. In our Foundry, for instance, the use of goggles and moulders' shoes is compulsory when necessary. In our Punch Press Department the use of pliers to handle materials between the jaws of a punch press is insisted upon. We have certain rules for handling electrical circuits and also regarding the operation of cranes which are compulsory. Our policy has been, however, rather to lead the men than to drive them, for leading the men creates a natural interest and obtains more loyal co-operation.

No. 14.—We started our educational work intensively in the early part of July last, when our accident rate for 1913 was at its highest point, and the attached curve shows the progress which has been made to date. The curve is plotted in terms of the ratio of accidents to the different weeks; the accidents occurring during the week over the average number of employees forms the ratio. This method was chosen so as to allow for the variation in the number of employees. Many other relations can be worked out, including such factors as accidents to man hours, ratio of total lost time to time worked, ratio of accidents to production, &c. The above ratio, however, has served our purpose, and we, therefore, expect to continue it.



Showing diminution in the accident rate throughout the year in the works of the General Electric Company, Pittsfield, U.S.A., during the years 1912, 1913 and 1914.

CONCLUSION.

From the results of our experience we feel justified in stating that in a country like America there is an enormous amount which can be done towards the reduction of accidents by the use of educational methods. As a final adjunct to this work we would like to see a method instituted whereby some central association like the National Association of Corporation Schools, or the American Museum of Safety, or the American Red Cross would award a gold medal to every individual who performs an unusual first aid service, such as resuscitating an unconscious comrade by the Prone Pressure method. If this extra stimulus could be given there is no question as to the increase in stability which it would bring about to the whole safety movement.

ILLUMINATING ENGINEERING SOCIETY (U.S.A.)
NINTH ANNUAL CONVENTION.

The following is a draft of the preliminary programme of the ninth annual convention of the Illuminating Engineering Society (U.S.A.), which is to be held at the New Willard Hotel, Washington, D.C., September 20—23 inclusive. The papers which promise to be of an unusually interesting character, are to be distributed over ten sessions. One of the sessions will be devoted especially to the subject of street lighting; commercial, general, and laboratory papers will each be given three sessions. Inspection trips, a reception, and a banquet are among the entertainment features.

PROGRAMME.

Sept. 20—(MORNING).

Formal opening of Convention.
Address of Welcome; President's Address, etc.
Reports of Committees on Lighting Legislation, Nomenclature and Standards, and Progress.

(AFTERNOON)—*General Session.*

"Tests and Experiments in Connection with the New Commonwealth Edison Company Building," by Messrs. W. A. Durgin and J. B. Jackson of the Commonwealth Edison Company of Chicago.
"Ship Lighting," by H. A. Hornor, N.Y. Shipbuilding Company, Camden, N.J.
"Illumination Efficiency as Obtained in an Experimental Room," by Ward Harrison, National Lamp Works of General Electric Co., Cleveland, Ohio.

(EVENING)—*Reception.*

Sept. 21—(MORNING)—*General Session.*

"Photometry with Portable Instruments," by W. F. Little, Electrical Testing Laboratories, New York, N.Y.
"New Test Plate for Illumination Photometers," by C. H. Sharp, Electrical Testing Laboratories, New York, N.Y.
"Incandescent Lamp Testing and Photometry," by G. W. Middlekauff, Bureau of Standards, Washington, D.C.
"Street Lighting," by F. A. Vaughn, consulting engineer, Milwaukee, Wisc.

(AFTERNOON)—*Entertainment, Trips.*

(EVENING)—*Street Lighting Session.*

"Gas Street Lighting" (author not yet announced), Welsbach Street Lighting Co.
"Arc Lamps for Street Illumination," by H. E. Clifford, Harvard University, Cambridge, Mass.
"New Types of Incandescent Lamps and Their Relation to the Street Lighting Problems," by W. H. Rolinson, Westinghouse Lamp Co., Bloomfield, N.J.
"Ornamental Street Lighting," by T. I. Jones, Edison Illuminating Company of Brooklyn.

Sept. 22—(MORNING)—*Commercial Session.*

"How to Attack a Lighting Problem," by W. R. Moulton, Consolidated Gas Electric Light & Power Company, Baltimore, Md.
"How Can a Combination Gas and Electric Company Render the Best Service to Customers," by Messrs. S. B. Burrows and N. H. Potter, Public Service Corporation, Newark, N.J.
"Small Incandescent Lamps and Special Illumination Problems," by R. P. Burrows, National Lamp Works of General Electric Company, Cleveland, Ohio.
"Lighting of Office Buildings," by A. O. Dicker, Commonwealth Edison Company, Chicago, Ill.

Laboratory Session.

"Crova's Method of Colored Light Photometry Applied to Modern Incandescent Illuminants," by Messrs. H. E. Ives and E. F. Kingsbury, Physical Laboratory of the United Gas Improvement Co., Philadelphia, Pa.

"Differences in Threshold and Acuity Variations," by P. W. Cobb, National Lamp Works, Cleveland, Ohio.

"Visual Efficiency," by Messrs. F. K. Richtmyer and Howes, Cornell University, Ithaca, N.Y.

"Yellow Screens," by M. Luckiesh, Nela Research Laboratory, Cleveland, Ohio.

(AFTERNOON)—*Commercial Session.*

"The Flame Pilot Ignition of Incandescent Gas Lamps," by C. W. Jordan, Physical Laboratory of the United Gas Improvement Co., Philadelphia, Pa.

"Practical Illumination as Exemplified by Some Recent Installations of Incandescent Gas Lamps," by R. F. Pierce, Welsbach Company, Gloucester, N.J.

"Mercury Arc Lamps for Industrial Lighting," by W. A. D. Evans, Cooper-Hewitt Company, Hoboken, N.J.

"Relation Between Proper Illumination and Accident Prevention," by R. E. Simpson, Travelers Insurance Co., Hartford, Conn.

Laboratory Session.

"Retinal Sensibilities in Relation to Illuminating Engineering," by P. G. Nutting, Eastman Kodak Company, Rochester, N.Y.

"The Effect of Distribution of Light on Muscular Control,"by H. M. Johnson, National Lamp Works, Nela Research Laboratory, Cleveland, Ohio.

"Effect of Various Wave Lengths of Radiation on Eye Cataract," by W. E. Berge.

Sept. 23—(MORNING)—*Commercial Session.*

"Artificial Illumination of Interiors," by David Crownfield, Pettingell-Andrews Company, Boston, Mass.

"Lighting of State, War and Navy Buildings," by W. E. Chapman, Assistant Superintendent, State, War & Navy Buildings, Washington, D.C.

"Lighting of Gymnasiums and Armories with Incandescent Lamps," by Messrs. A. L. Powell and A. B. Oday, Edison Lamp Works, Harrison, N.J.

Laboratory Session.

"The Effect of Surrounding Gas on an Incandescent Filament," by C. F. Lorenz, National Lamp Works of General Electric Co., Cleveland, Ohio.

"The Parabolic Mirror," by F. A. Benford, jun., General Electric Co., Schenectady, N.Y.

A paper (subject to be announced later) by C. E. Ferree, Bryn Mawr College, Bryn Mawr, Pa.

(AFTERNOON)—*General Session.*

"Artificial Illumination in Practical Photography," by C. E. K. Mees, Eastman Kodak Company, Rochester, N.Y.

"Photographic and Visual Illumination Efficiencies," by L. A. Jones, Eastman Kodak Company, Rochester, N.Y.

"Production and Application of Ultra-Violet Light," by M. Von Recklinghausen.

"A Flux Method of Obtaining Average Illumination," by Messrs. F. A. Benford and H. E. Mahan, General Electric Company, Schenectady, N.Y.

Information regarding the convention may be had upon application to the General Office of the Society, 29, West 39th Street, New York, N.Y.

LECTURES ON HYGIENE AND SANITATION.

The Royal Sanitary Institute announce a series of lectures and demonstrations for Sanitary Officers to take place September—November, 1915, relating to municipal hygiene, public health disinfection, water supply, &c. The course also includes a series of seven lectures on meat and food inspection.

Another series of lectures is announced to assist School Teachers and others entering for the examinations in School Hygiene, commencing on October 4th, 1915.

Particulars can be obtained from the Secretary, Mr. White Wallis, Royal Sanitary Institute, Buckingham Palace Road, London, S.W.

SHORT NOTES ON ILLUMINATING ENGINEERING.

THE LIGHTS OF PARIS.

The *Edison Monthly* for July has a very apposite article on the lights of Paris. At the present time the illumination is far below what is associated with the "City of Light," although the city is said to have already emerged somewhat from the deep gloom (physical, not mental!) that existed earlier in the campaign.

The adjacent illustration is reproduced from a highly spectacular night photograph, showing a silhouette of one of the famous gargoyles of Notre Dame, presumably taken before the war began. Most characteristic of the Paris is the special festive illumination that takes place normally on July the 14th. At the present time these illuminations are naturally in abeyance, but we may hope that the time is not far distant when Paris will be the City of Lights once more.

MACHINERY PAINTED WHITE.

A Novel Method of Improving Conditions of Illumination in Factories.

According to *Popular Mechanics* the practice is being adopted in some factories in the United States of painting all machinery with a white oil-proof enamel. The ceilings are painted with the same material whenever possible, so as to facilitate the use of indirect lighting.

It is said that the light reflected from the machinery is most valuable in eliminating inconvenient shadows and diffusing the illumination. In one case it was found possible to take a photograph in such a workshop in one-seventh of the exposure that would have been required had ordinary unpainted machinery been used.

LUMINOUS GLOVES FOR TRAFFIC REGULATORS.

Attention was recently drawn in The Illuminating Engineer to the proposal that the curbs of pavements in London should be painted white in order to facilitate traffic—a useful suggestion in these days of diminished public lighting.

An even more remarkable step is said to have been recently adopted in St. Louis, where traffic policemen have been provided with white patent leather gauntlets, to be worn when directing traffic.* The glossy surface of these gloves is stated to reflect the rays of light directed against them from street and motor car lamps, rendering the extended hand of the policemen so conspicuous that it can often be seen by the driver before the figure of the policeman itself is discernible.

In view of the present diminished lighting of the streets any devices of this kind are worth consideration.

* *Popular Mechanics*, August, 1915.

THE EMPIRE FAIR.

An interesting event in 1917 is to be the organisation of a great exhibition devoted to the industries of the Empire. So far as human foresight can predict, there should be great scope for such an effort two years hence, and we gladly publish the following letter relating to the scheme :—

To the Secretaries of Trade Associations and Societies.

Sir,

Re " The Industries of the Empire Fair.'

For the purpose of accommodating a Fair embracing all the industries of the Empire, an exhibition building is about to be erected in London, and will be completed by the spring of 1917. The area of the building will be approximately three times that of the largest exhibition building now existing in London, and will be known as the Palace of Industry.

A Fair of this magnitude being of national importance must not be promoted on the lines of a private enterprise. It is, therefore, suggested that the profits of the Fair be distributed amongst the firms taking part, in proportion to the space they occupy.

In order to protect the interests of the various trades, an Advisory Council is being formed, embracing representatives of the responsible Trade Associations and Societies of the country.

The Secretary of the Fair will be glad to receive the name of any Association or Society that has not already nominated an official to act on the aforesaid Advisory Council.

Faithfully yours,

William Glass.

Secretary to the Industries of the Empire Fair,
Lincoln House, High Holborn,
London, W. C.

July 26th, 1915.

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED.

Picture Play Photography. By H. M. Lomas. (*Ganes, Ltd.*, 85, *Shaftesbury Avenue, London, W.*, 1914, 5*s.*; 169 *pages, 52 illustrations.*)

AN article on the applications of light in connection with cinematograph work recently appeared in this journal. The view expressed therein, that there is considerable scope for the lighting expert in this field, is illustrated by this readable little book, in which optical and visual problems are frequently discussed.

In the first chapters there is an interesting account of the development of the art of taking moving pictures. We see how their original application for scientific purposes was first appreciated, how presently they became a source of entertainment as well as instruction, and how of recent years new life was given to the industry by the representation of pictorial drama. Few outsiders realise the high technical skill and the peculiar artistic and dramatic instincts required to produce a good film. The author shows how the producer needs to appreciate the essentials of clear vision and the recording of movement. Scene lighting and the arrangement of lights play a great part in the production, the aim being to bring out the chief actors and prominent incidents and to relegate subsidiary details to the background. A chapter is devoted to lamps, reflectors, and dispersing screens, which are dealt with in a popular and rather summary manner. Some objection might be raised by an engineer to the rather crude explanations of electrical terms and to the statement that "the light from mercury vapour lamps is very similar to that from enclosed arcs." One would also like to have a more detailed analysis of the photographic efficiency of various illuminants.

The information on the arrangement of lamps and use of diffusing screens, &c., with a view to getting the correct shadow effects is most interesting and is illustrated by some clear sketches. The author points out the danger of using over-brilliant unscreened light sources, the glare from which is apt to give a strained look to the faces of actors, and even to cause inflammation of the eyes.

The latter section of the book is devoted mainly to photographic and technical details. We notice that he advocates a judicious amount of diffused illumination in the dark room—not enough to cause any risk of fog, but sufficient to enable operators to see their way about. In the final chapter some curious instances of selective action on the part of photographic plates are given, such as the reappearance in the negative of a name which had been painted out on the hull of a ship, and the appearance of stripes on the coat of an animal, which were invisible to the naked eye.

The book is written in an entertaining and popular manner and should be interesting to many whose business is not closely identified with cinematograph work.

Gas Engineering and Gas Manufacture: A Review of the Institution of Gas Engineers. Edited by Chas. W. Hastings. (*J. G. Hammond & Co., Ltd., City Works, Fleet Lane, London, E.C.*, 1915; 2*s. net.*)

WE receive Part I. of this review, the publication of which will be completed in six parts.

Part I. carries us from the foundation of the Institution in 1863 (as The British Association of Gas Managers) up to 1883, when the International Electric and Gas Exhibition took place at the Crystal Palace. To those in the gas industry the review should be of special historical interest, but many who are interested in general lighting questions will find this a complete summary of papers read before the Institution.

Mr. Hastings, who is known to our readers as a veteran in this field, has arranged his matter in a convenient and readable form. The text is printed on matt paper, and the portraits of Presidents on art paper insets. Looking through the pages of the Review we notice references to many interesting incidents and papers. We note, for example, the historic work of Mr. John Methven on flame standards of light, an interesting paper by Mr. Wm. Sugg on the Applications of Gas to the Lighting of Open Spaces and Large Buildings (in the course of which he refers to the celebrated experiments at the South Forelands Lighthouse), and a paper by Prof. A. G. Vernon Harcourt on the Pentane Standard.

Mr. Hastings has compiled a readable and interesting review, and we shall look forward to the appearance of the other parts in due course.

"*Halifax, A Commercial and Industrial Centre,*" *an Illustrated Handbook concerning the Town's Present Position and Future Promise.* (*Published for the Halifax Chamber of Commerce, Chamber of Trade and Advertising Club, by Sell's, Ltd.*, "*At the Sign of the Sundial,*" 166-169, *Fleet Street, London, E.C. Quarto, 2s. 6d.; by post, 2s. 10d.*)

THIS booklet contains a summary of the position of Halifax as a commercial and industrial centre. Statistics are given showing the advantages of the locality as a residential area, and the book also contains many illustrations of features of interest and natural beauty around Halifax. There is also an account of the various engineering activities of the City, which have made great strides in recent years.

CORRESPONDENCE.

SHOP LIGHTING IN WAR TIME.

July 24th, 1915.

DEAR SIR,

In December last I sent a letter to your paper in regard to Shop Window Lighting in War Time, dealing with the amateurish attempts made by shopkeepers to conform to regulations. I drew attention to the much favoured method of wrapping tissue paper around bare lamps, and pointed out that not only was this very ineffective, but was a distinct source of danger, as witnessed by the large amount of badly scorched tissue paper seen.

The note of warning which I struck in that letter was amply justified in the Press this week, where it was stated that the L.C.C. Fire Brigade was recently called to an outbreak of fire caused by crinkled paper round electric lamp bulbs in a shop window. One is led to wonder how many small outbreaks, not necessitating the attendance of the fire brigade, have been caused by this highly dangerous practice. The method I mentioned in my December letter was the scientific lighting of shop windows by means of concealed lighting units placed high in the window. This method ensures the effective lighting of the articles displayed with complete control to accord with the lighting restrictions of the Police—and has the additional merit of being safe and free from danger of fire. A large number of shops have been lighted on this approved plan and give absolute satisfaction to all concerned.

Yours very truly,

F. W. WILLCOX,

General Manager,
Lamp and Wiring Supplies Dept.,
The British Thomson-Houston Co., Ltd.

TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we have extended the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

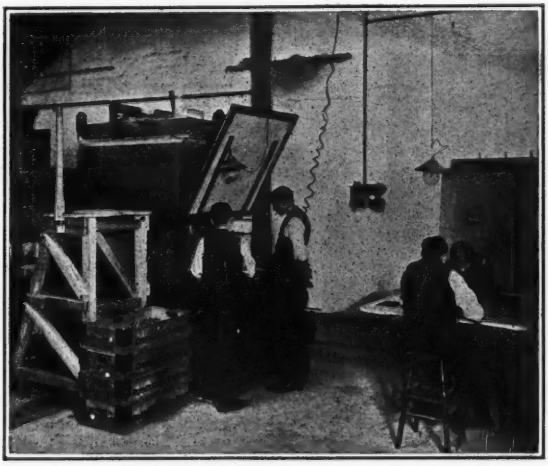
The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

BRITISH-MADE ELECTRIC LAMP CAPS.

Since the commencement of the war the lamp manufacturers in this country have been faced by various special conditions, arising from the disconnection with the Continent.

As an instance we may mention the manufacture of the caps of electric incandescent lamps. It has been generally assumed that these caps were invariably imports from abroad, and it is therefore of interest to learn that the Osram Lamp Works, Ltd. and the Robertson Lamp Works, Ltd. manufacture these at their Hammersmith factories.

The illustration shows part of the cap-making plant of these companies at Hammersmith, and we are informed that this is the first illustration of an English cap-making plant to be published. We also understand that the Osram and Robertson Companies manufacture every other part of their incandescent lamps at Hammersmith with the exception of the glass bulbs which, as hitherto, are made at Lemington-on-Tyne. Both companies, therefore, are independent of any foreign source of supply.



BLERIOT "NO-GLARE" LAMPS.

From Messrs. Bleriot, Ltd., we receive particulars of the Bleriot No-Glare Lamp for motorists, the essential principle of which is the use of a series of horizontal deflecting plates, for directing and modifying the beam. In this way the light is concentrated along the roadway, and at the sides of the road, where it is mainly needed, but the inconvenient upward rays are suppressed.

MAZDA HALF-WATT LAMPS.

A RECENT B.T.H. leaflet summarises in a readable manner some of the chief applications of Mazda Half-Watt Lamps, of which the following sizes are now available :—

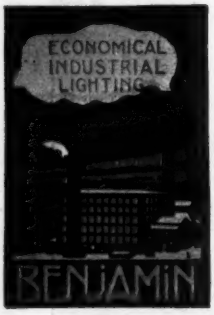
15, 30, 60 & 100 watts ..	25 volts
30 & 60 watts	50—65 ,,
60 & 100 watts	100—130 ,,
100, 150, & 200 watts ..	200—255 ,,

It seems but a short time since the advent of the ordinary 60-watt metal filament lamp for 100 volt circuits was considered a remarkable step. Now the leading lamp manufacturers are actually offering " Half-Watt " lamps in this size. Doubtless the time is not far distant when " Half-Watt " lamps in all the customary sizes will be obtainable.

The booklet has a striking cover and also contains particulars of fittings for these lamps. There are also photographs of installations in Selfridge's and of the effective display of these lamps in Leeds City Square.

——o——

BENJAMIN POSTER STAMP.



Above is a new Poster Stamp, one of three issued by **The Benjamin Electric, Ltd.,** 1a, Rosebery Avenue, London, E.C.

——o——

EDISWAN " KINGOLITE " CANDLES.

IN all probability the candle is so deeply entrenched in the public mind as the traditional lighting unit that " electric candles " will be with us for a long time to come. A booklet describing the **Ediswan " Kingolite "** type, draws attention to the rigid character of this form of candle. The construction enables it to be screwed down firmly without any danger of deviation from the perpendicular. Some attractive illustrations of sconces and portable lamps equipped with this candle are given.

We also note the Ediswan leaflet No. A 3112 relating to **Circuit Breakers.**

——o——

A WELL-LIGHTED TAILORY AND HOSIERY SHOP.

THE two views on the opposite page give an excellent idea of the lighting of a tailory and hosiery shop (Percy Harrison, Thames Street, Kingston-on-Thames). The upper illustration shows the appearance of the windows by night, the lower one the lighting of the interior. The entrance is effectively lighted by two Holophane Stiletto Bowls, and the contents of the windows by means of 32-watt lamps in F. 60 reflectors placed in the cornice, so as to be well above the goods and out of the direct range of sight.

The illumination in the window is about 4-6 ft.-candles, on the counters about 4 ft.-candles, and the general illumination in the shop about 3 ft.-candles. The interior gives the impression of being quite brightly lighted.

An advantage of this method of lighting at the present time is that, if desired, the lights can be readily screened, so as to be invisible from the pavement. The requirements of the Authorities can thus be complied with, without interfering with the illumination of the goods.

——o——

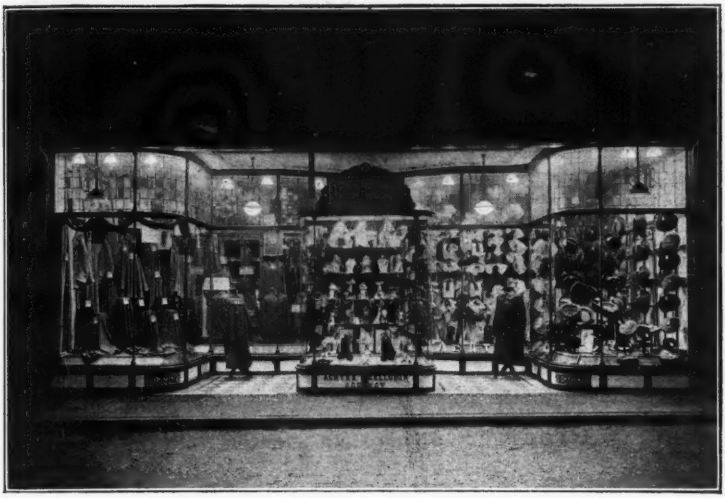
RAILWAY STATION LIGHTING.

We notice in *Electricity* an account of the lighting of the Caledonian Railway Co.'s station at Glasgow, which is now lighted by Osram 500 watt Atmos lamps.

It is stated that an improved illumination, as well as a considerable diminution in consumption of electricity has been secured. The horizontal illumination in the main hall is given as 2 ft.-candles maximum, with a minimum of 1·7 ft.-candles, while along the platforms the variation lies between 0·8 and 1·6 ft.-candles.

——o——

Messrs. Siemens Bros. Dynamo Works, Ltd., inform us that the company has again secured the contract for the supply of Tantalum Traction Lamps to the Borough of Leith for the ensuing twelve months.



Inside and outside views of Percy Harrison's Tailory and Hosiery Establishment (Thames Street, Kingston), lighted by tungsten lamps and Holophane reflectors.

(Photos. taken entirely by artificial light.)

THE NATIONAL PHYSICAL LABORATORY.

Report for the Year 1914–1915.

The Report of the National Physical Laboratory for the past year again continues evidence of the useful work this Institution is carrying on. It is stated that 25 per cent. of the staff have joined the colours, and the presence of the remainder is very properly desired by the authorities in order to carry on the work of the laboratory. In addition to the ordinary work there have been special problems in connection with the war, the optical and aeronautical departments in particular being busy with problems of this kind.

Reference is made to the papers on photometry read by Messrs. C. C. Paterson and B. P. Dudding before the Physical Society during the year and to the systematic redeterminations of the Unit of Light, which agree with those made previously within 0·1 per cent. An investigation is also being made into the coefficients of reflection of the white cards used with illumination photometers.

A very considerable amount of work has been done in connection with the Home Office Committee on Factory Lighting, and on the subject of Ships' Navigation Lights, &c.

We note that the financial results of the year have been adversely affected by the war. The proposed scheme of relieving the Royal Society of the financial responsibility in regard to the Laboratory, and obtaining additional support from public funds does not appear to have made material progress since the matter was brought to the notice of the Premier, in July, 1914.

Let us hope that one result of this unhappy war will be a fuller recognition of the value of scientific research, and that the National Physical Laboratory will receive the support it needs and deserves.

PERSONAL.

Sub-Lieutenant A. R. Courtenay.

Ever since this country became involved in the now world-wide war, the General Electric Co., Ltd., has furnished a considerable number of officers and men—several of whom have already won distinction in the field. The newest officer recruit is Sub-Lieutenant A. R. Courtenay (late Acting Manager of the G.E.C. Publication Department).

Sub-Lieutenant Courtenay was always most enthusiastic and determined over everything that he took up, in addition he was most popular among those with whom he came in contact.

These valuable characteristics will now, doubtless, serve him in good stead in his new position. He was gazetted on May 20th Sub-Lieutenant in the Royal Naval Air Service, Armoured Car Aeroplane Support (Royal Naval Volunteer Reserve), and is now undergoing a course of gunnery.

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£250 TWO HUNDRED AND FIFTY POUNDS will be paid by the above Corporation to the legal personal representatives of any person who is killed by an accident causing material damage to the passenger train in which the deceased was travelling as a ticket bearing or paying passenger, or who shall have been fatally injured thereby, should death result within one calendar month after such accident. **Provided** that the person so killed or injured had upon his or her person, or had left at home this coupon, with his or her usual signature, written prior to the accident, in the space provided below, which, together with the giving of notice within seven days to the above Corporation is the essence of this contract.

This Insurance only applies to persons over 14 and under 65 years of age, is subject to the conditions stated above and contained in the General Accident Fire and Life Assurance Corporation Act, 1907, and holds good for the current month of issue only.

No person can recover under more than one Coupon Ticket in respect of the same risk.

Signature .....

This Coupon must not be cut out, but left intact in THE ILLUMINATING ENGINEER as that being dated, forms the only evidence of its currency.

GAS AND MUNITIONS OF WAR.

In this journal there recently appeared an abstract of a paper by Mr. Broadberry describing some examples on the Use of High Pressure Gas Lighting in Modern Factories. At the present time, when so many factories are working overtime on Government contracts, and we are approaching the period of the year when artificial light will be mainly used there is a great demand for suitable lighting and manufacturers are quick to appreciate the important part played by good illumination in increasing the output, and maintaining the quality of work.

But apart from the use of gas for lighting factories of this kind, it has many special applications in munitions work, some of which were briefly mentioned by Mr. Thornton in his recent address before the Royal Society of Arts on the Use of Coal Gas for Industrial purposes. For example the heat treatment of shells—a matter of vital interest to our national existence at the present moment—is largely carried out by the use of gas furnaces. Even the huge shells are to-day being treated in this country in gas furnaces; one such furnace recently installed can turn out at one charge eleven of the giant naval armour-piercing shells—each shell weighing approximately one ton. Furnaces are also used for the welding of bayonet handles to their blades.

In some instances manufacturers have been enterprising enough to change the entire nature of their business at short notice. For example one firm which previously manufactured musical instruments found their trade in war time considerably lessened. Accordingly some gas furnaces were ordered, and installed in a few days, and the same shop is now devoted to the tempering and colouring of small steel cartridge clips. Gas furnaces are also widely used in air-craft factories.

There are, however, many subsidiary operations, apart from the manufacture of actual weapons, which are quite as essential at the present moment. Take for example the finishing off of boots for the army by gas heated irons and the "treeing" (*i.e.*, making the boots take the exact shape of the last on which they are modelled); or again, take the making of peaked caps, in which use of gas irons plays a conspicuous part.

In the clothing industry millions of yards of material are singed by gas in order to burn off all the loose threads from the cloth. The cloth is then run through water to extinguish any sparks and is left in the water until it undergoes the subsequent operations of bleaching or scouring. Next there is the operation of "tentering" or stretching the cloth which is passed over a copper sheet heated by gas flames, thus driving out steam and moisture.

Lastly, we must not forget the value of gas for driving machinery. Small gas engines are widely used, and recently some very large engines have been developed. For example in the new pumping station of the L.C.C. at Barking there are seven 500 H.P. engines, each of which consumes about 7000 cubic feet of gas per hour and can pour nearly 100 tons of London sewage every minute into the sterilising tanks and purify it before it runs into the Thames.